PASSAIC RIVER BASIN,
TRIBUTARY TO MORSETOWN BROOK,
PASSAIC COUNTY
NEW JERSEY.

AD A103755

CARPI LAKE DAM
(NJ 00192)

PHASE 1 INSPECTION REPORT.
NATIONAL DAM SAFETY PROGRAM.

DEPARTMENT OF THE ARMY

Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

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JULY 1981

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Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program
Embankments	Carpi Lake Dam, N.J.
Visual Inspection	Spillways
Structural Analysis	Erosion

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report. ⟶ page 1

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IN REPLY REFER TO

NAPEN-N

31 AUG 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Carpi Lake Dam in Passaic
County, New Jersey which has been prepared under authorization of the Dam
Inspection Act, Public Law 92-367. A brief assessment of the dam's
condition is given in the front of the report.

Based on visual inspection, available records, calculations and past
operational performance, Carpi Lake Dam, initially listed as a high hazard
potential structure, but reduced to a significant hazard potential structure
as a result of this inspection, is judged to be in poor overall condition.
The dam's spillway is considered inadequate because a flow equivalent to 47
percent of the Spillway Design Flood - SDF - would cause the dam to be
overtopped. (The SDF, in this instance, is one half of the Probable Maximum
Flood). To ensure adequacy of the structure, the following actions, as a
minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified
professional consultant engaged by the owner using more sophisticated
methods, procedures and studies within six months from the date of approval
of this report. Within three months of the consultant's findings remedial
measures to ensure spillway adequacy should be initiated.

b. Within one year from the date of approval of this report the owner
should engage a qualified professional consultant to perform the following:

(1) Investigate the cause of wet, soft areas and standing water at
the downstream toe of the dam.

(2) Investigate the uneven condition of the dam crest and design or
specify measures to correct this condition.

(3) Design or specify the repairs for the erosion of the upstream
slope and oversee the placement of adequate erosion protection for the
upstream slope of the dam.

(4) Specify and oversee removal of trees, brush and vines from the entire embankment.

(5) Design and oversee replacement of the collapsed right, downstream concrete spillway training wingwall.

(6) Design and oversee the placement of adequate erosion protection along the toe of the embankment adjacent to the discharge channel.

(7) Design and oversee repairs to deteriorated concrete on the spillway and low-level outlet valve pit.

c. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) Start a program of periodically checking the condition of the dam and monitoring the wet area along the toe of the downstream slope.

(2) Remove trees and brush for a distance of 25 feet downstream from the toe of the dam or to the property line, whichever is less.

(3) Control trespassing on the dam.

d. Within one year from the date of approval of this report the following remedial actions should be initiated:

(1) Re-establish and maintain grassy vegetation on the dam after removal of trees, brush, vines and repair of eroded areas on the dam.

(2) Clear trees and brush on either side of the spillway discharge channel for distance of 100 feet from the spillway crest or to the limits of the property line whichever is less.

(3) Clean and paint all rusted steel on the service bridge.

(4) Repair or replace steel ladder in valve pit.

e. The owner should develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam, within one year from the date of approval of this report.

f. An emergency action plan and warning system should be developed which outlines actions to be taken by the owner to minimize the downstream effects of an emergency at the dam within six months from the date of approval of this report.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Roe of the Eighth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

NAPEN-N
Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical
Information Services (NTIS), Springfield, Virginia 22161 at a reasonable
cost. Please allow four to six weeks from the date of this letter for NTIS
to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation
of the recommendations made as a result of the inspection. We accordingly
request that we be advised of proposed actions taken by the State to
implement our recommendations.

Sincerely,

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

1 Incl
As stated

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

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3

CARPI LAKE DAM (NJ00192)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 23 April 1981 by Anderson-Nichols and Co. Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Carpi Lake Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in poor overall condition. The dam's spillway is considered inadequate because a flow equivalent to 47 percent of the Spillway Design Flood - SDF - would cause the dam to be overtopped. (The SDF, in this instance, is one half of the Probable Maximum Flood). To ensure adequacy of the structure, the following actions, as a minimum, are recommended:

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within six months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated.

b. Within one year from the date of approval of this report the owner should engage a qualified professional consultant to perform the following:

(1) Investigate the cause of wet, soft areas and standing water at the downstream toe of the dam.

(2) Investigate the uneven condition of the dam crest and design or specify measures to correct this condition.

(3) Design or specify the repairs for the erosion of the upstream slope and oversee the placement of adequate erosion protection for the upstream slope of the dam.

(4) Specify and oversee removal of trees, brush and vines from the entire embankment.

(5) Design and oversee replacement of the collapsed right, downstream concrete spillway training wingwall.

(6) Design and oversee the placement of adequate erosion protection along the toe of the embankment adjacent to the discharge channel.

(7) Design and oversee repairs to deteriorated concrete on the spillway and low-level outlet valve pit.

c. Within six months from the date of approval of this report the following remedial actions should be initiated:

(1) Start a program of periodically checking the condition of the dam and monitoring the wet area along the toe of the downstream slope.

(2) Remove trees and brush for a distance of 25 feet downstream from the toe of the dam or to the property line, whichever is less.

(3) Control trespassing on the dam.

   d. Within one year from the date of approval of this report the
following remedial actions should be initiated:

   (1) Re-establish and maintain grassy vegetation on the dam after
removal of trees, brush, vines and repair of eroded areas on the dam.

   (2) Clear trees and brush on either side of the spillway discharge
channel for distance of 100 feet from the spillway crest or to the limits of
the property line whichever is less.

   (3) Clean and paint all rusted steel on the service bridge.

   (4) Repair or replace steel ladder in valve pit.

   e. The owner should develop written operating procedures and a periodic
maintenance plan to ensure the safety of the dam, within one year from the
date of approval of this report.

   f. An emergency action plan and warning system should be developed
which outlines actions to be taken by the owner to minimize the downstream
effects of an emergency at the dam within six months from the date of
approval of this report.

APPROVED: _____

ROGER L. BALDWIN
Lieutenant Colonel, Corps of Engineers
Commander and District Engineer

DATE: _____

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

|	
Name of Dam:	Carpi Lake
Identification No.:	Fed ID No. NJ00192
State Located:	New Jersey
County Located:	Passaic
Stream:	Morsetown Brook
River Basin:	Passaic
Date of Inspection:	April 23, 1981

ASSESSMENT OF GENERAL CONDITIONS

Carpi Lake Dam is about 50 years old and is in poor condition.
The dam is 300 feet long, 12.1 feet high, and about 20 feet
wide. The dam is small and its hazard classification is sig-
nificant. The earthen embankment contains a central axial
concrete core wall, a 12-inch low-level outlet with valve box
cast integrally with the core wall, and a 25-foot ogee spillway
located near the left abutment. The downstream slope is covered
with vines, brush, and trees and the area downstream of the toe
is generally wet and soft. The retreat channel runs along the
downstream toe for about 50 feet. The right side training
wingwall from the spillway has collapsed into the channel ex-
posing the embankment and dumped riprap. The upstream slope,
with several trees growing at or above the waterline, shows
evidence of erosion and displacement of riprap at and above
the waterline. The grass covered dam crest is rather uneven.
Several roots of trees extend the entire width of the crest.
The spillway's crest has some minor spalling of concrete and
a small crack near the toe. The spillway is capable of passing
46 percent of the selected spillway design flood inflow hydrograph
of one-half PMF (652 cfs) and is considered inadequate.

The owner should engage a professional engineer, qualified in
the design and construction of dams to accomplish the following
in the near future: evaluate further the adequacy of the spill-
way capacity and design and oversee construction of additional
capacity, if found necessary; investigate the cause of wet,
soft areas and standing water at the downstream toe of the
dam; investigate the uneven condition of the dam crest and
design or specify remedial measures to correct the condition;
design or specify the repairs for the erosion of the upstream
slope and oversee the placement of adequate erosion protection
for the upstream slope of the dam; specify and oversee removal
of trees, brush and vines from the entire embankment; design
and oversee replacement of the collapsed right, downstream
concrete training wingwall; design and oversee the placement
of adequate erosion protection along the toe of the embankment
adjacent to the discharge channel; design and oversee repairs
to deteriorated concrete on the spillway and low-level outlet
valve pit.

It is further recommended that the owner accomplish the follow-
ing tasks as part of operational and maintenance procedures.
Beginning soon: start a program of periodically checking the
condition of the dam and monitoring the wet area along the toe
of the downstream slope; develop an emergency action plan which
outlines actions taken by the owner to minimize downstream
effects of an emergency at the dam; remove trees and brush for
a distance of 25 feet downstream from the toe of the dam or to
the property line, whichever is less; control trespassing on
the dam. In the near future: re-establish and maintain grassy
vegetation on the dam embankment; clear trees and brush on
either side of the spillway discharge channel for a distance
of 100 feet from the spillway crest or to the limits of the
property line, whichever is less; clear and paint all rusted
steel on the service bridge; repair or replace steel ladder
in valve pit; and develop written operating procedures and a
periodic maintenance plan to ensure the safety of the dam.

                         ANDERSON-NICHOLS & COMPANY, INC.

                         Warren A. Guinan
                         Warren A. Guinan, P.E.
                         Project Manager
                         New Jersey 16848
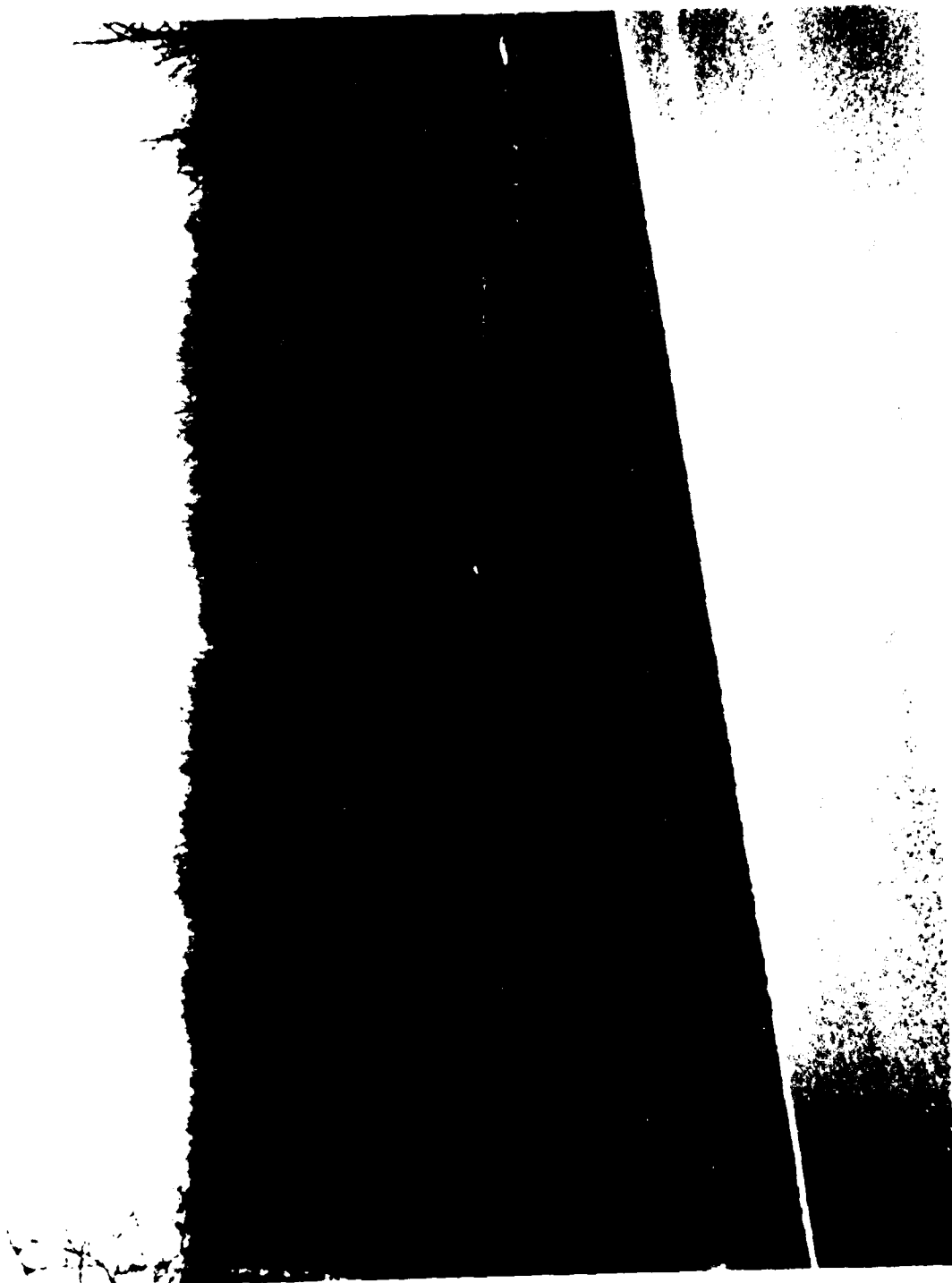
April 23, 1981

OVERVIEW PHOTO
CARPI LAKE DAM

PREFACE

This report is prepared under guidance contained in the *Recommended Guidelines for Safety Inspection of Dams*, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonable possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY REPORT

CARPI LAKE DAM FED ID NO. NJ00192

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION PROGRAM
CARPI LAKE DAM
FED ID NO. #NJ00192

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. Authority to perform the Phase I Safety
Inspection of Carpi Lake Dam was received from the State of New
Jersey, Department of Environmental Protection, Division of
Water Resources by letter dated 12 December 1980 under Basic
Contract No. FPM-39 and Contract No. A01093 dated 10 October,
1979. This Authority was given pursuant to the National Dam
Inspection Act, Public Law 92-367 and by agreement between the
State and the U.S. Army Engineers District, Philadelphia. The
inspection discussed herein was performed by Anderson-Nichols &
Company, Inc.

b. Purpose: The purpose of the Phase I Investigation is
to develop an assessment of the general conditions with respect
to the safety of Carpi Lake Dam and appurtenances. Conclusions
are based upon available data and visual inspection. The
results of this study were used to determine any need for
emergency measures and to conclude if additional studies,
investigations, and analyses are necessary and warranted.

1.2 Project Description

a. Description of Dam and Appurtenances. Carpi Lake Dam
is a 300-foot long, 12.1-foot high earthfill dam with a
concrete core wall. The dam crest is approximately 20 feet
wide; the slopes are 3H:1V on the upstream side and 2H:1V on
the downstream side. The ogee spillway is 25 feet long, 16
feet wide including the downstream apron, and 8.5 feet high.
The spillway has concrete abutment training walls and is
located on the left (west) side of the dam. A concrete slab
bridge crosses the spillway.

b. Location. Carpi Lake Dam is located on
Morsetown Brook in West Milford Township, Passaic County, New
Jersey. The dam is at 41° 06.7' north latitude 74° 21.3'
west longitude on the Wanaque Quadrangle. To reach the dam
from the nearby township of West Milford go east from the
center of town on Marshall Hill Road. Turn right and proceed
south for approximately 1 mile on Morsetown Road. Carpi Lake
is on the right (west) side of the road. A location map has
been included as Figure 2.

c. Size Classification. Carpi Lake Dam is classified as being small in size on the basis of storage at top of dam of 83 acre-feet, which is less than 1000 acre-feet but more than 50 acre-feet, and on the basis of its structural height of 12.1 feet, which is less than 40 feet, in accordance with criteria given in the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification. Downstream of Carpi Lake Dam are two small ponds. Morsetown Road crosses Morsetown Brook, the downstream channel, between the two ponds. Around the second pond are several houses whose back porches are approximately 6 feet above the water. If the dam were overtopped, Morsetown Road could possibly be damaged and minor flooding might occur at 4 to 6 houses around the second downstream pond. Damage to Morsetown Road would probably be appreciable; but few, if any, lives would be lost. Therefore, Carpi Lake Dam is given a significant hazard classification.

e. Ownership. The dam is owned by Helen Iafrate, West Milford, New Jersey 07480; for information she may be reached at the above address.

f. Purpose. The dam impounds a lake which is used for recreational purposes.

g. Design and Construction History. According to the owner, the dam was constructed between 1929-1939 and designed by Caesar Carpiniano. Plans for the dam were found in the files of the New Jersey Department of Environmental Protection, 1474 Prospect Street, Trenton, New Jersey 08625. However, no hydraulic or hydrologic data were discovered.

h. Normal Operational Procedure. No operational procedures exist for the dam.

i. Site Geology. No site specific geologic information (such as borings) was available at the time the dam was inspected. Information derived from the Geologic Map of New Jersey (Kummel and Lewis, 1912) and the Glacial Drift Map of New Jersey (Salisbury, Kummel, Peet and Whitson, 1902) indicates that soils within the immediate site area consist of ground moraine overlying bedrock. Bedrock was observed in several outcrops at the left side of the downstream channel during inspection of this dam. The previously mentioned map indicates that bedrock in this area consists of granitoid gneiss of Precambrian age.

1.3 Pertinent Data

a. **Drainage Area**

.28 square miles

b. **Discharge at Damsite (cfs)**

Maximum flood at damsite - unknown

Total ungated spillway capacity at maximum pool
(top of dam) elevation - 205

c. **Elevation (ft. above NGVD)**

Top of dam - 937.4

Maximum pool test flood - (1/2 PMF) - 938.4

Recreation pool (at time of inspection) - 935.8

Spillway crest - 935.7

Streambed at centerline of spillway - 927.2

Maximum tailwater - (estimated) 928.5

d. **Reservoir (feet)**

Length of maximum pool - 3000 (estimated)

Spillway crest - 1400

e. **Storage (acre-feet)**

Spillway crest - 57

Top of dam - 83

Test Flood - (1/2 PMF) - 100

f. **Reservoir Surface (acres)**

Top of dam - 19 (estimated)

Spillway crest - 12.8

g. **Dam**

Type - earthfill with concrete corewall and spillway

Length - 300 feet

Height - 10.2 feet (hydraulic)

- 12.1 feet (structural)

Top width - 20 feet

Side slopes - upstream 3H:1V, downstream 2H:1V

Zoning - unknown

Impervious core - concrete

Cutoff - unknown

Grout curtain - unknown

h. Spillway

Type - Ogee

Length of weir - 25 feet

Crest elevation - 935.7' NGVD

Low level outlet - 12-inch C.I.P.

U/S Channel - Carpi Lake

D/S Channel - Morsetown Brook

i. Low-Level Outlet

Size - 12-inch C.I.P.

Access - Valve box near spillway, centered on corewall

Upstream invert elevation - 927.2 (est.)

Downstream invert elevation - 927.0 (est.)

SECTION 2
ENGINEERING DATA

2.1 Design

The original plans for Carpi Lake Dam are on file at the New Jersey Department of Environmental Protection, 1474 Prospect Street, Trenton, New Jersey 08625. According to the owner of the dam, Ms. Helen Iafrate, the dam was designed by Caesar Carpiniano. No hydraulic or hydrologic engineering data were disclosed.

2.2 Construction

No recorded data concerning the original construction of Carpi Lake Dam were revealed.

2.3 Operation

No data pertaining to the operation of the dam were disclosed.

2.4 Evaluation

a. Availability. A search of the New Jersey Department of Environmental Protection files and contact with the owner and community officials revealed no other pertinent information except for the plan of the dam.

b. Adequacy. Evaluation was based primarily on visual observations which are deemed adequate for this Phase I inspection.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. Dam. The downstream slope of the dam is covered with a very dense growth of trees, brush, vines, and miscellaneous debris which makes it impossible to inspect the downstream slope adequately. The right concrete training wing wall of the spillway, which is 15 feet long, has collapsed into the discharge channel immediately downstream from the spillway exposing the embankment soils. The downstream slope is covered with dumped riprap from the crest to the toe adjacent to the downstream end of the collapsed concrete training wing wall. At one location to the left of the service bridge over the spillway is a footpath which is mostly bare of vegetation from the crest to the toe of the slope.

The crest of the dam is rather uneven and mostly covered with grass. Several trees are growing at or above the waterline on the upstream slope. Several large roots were observed extending the entire width of the crest. Considerable erosion has occurred on the upstream slope at and above the waterline resulting in displacement of several sections of riprap.

The area downstream of the toe of the dam is covered with trees, vines, and brush and is generally wet and soft. Some standing water was noted downstream of the dam but no evidence of flowing water was observed. Several trees have blown over downstream of the toe.

The top of the concrete corewall is spalled and eroded. No evidence of major thru wall cracking or movement was noted.

b. Appurtenant Structures.

(1) Ungated Spillway. The downstream face of the spillway in the vicinity of the 2-inch notch in the crest is surface eroded approximately 3/4 of an inch exposing the coarse aggregate. A wet spot on the downstream face was visible near the bottom left end. The concrete abutments at the end of the spillway are eroded at the waterline upstream of the spillway. A large section of the right concrete spillway training wing wall has collapsed adjacent to the spillway (See Section 3.1.a above).

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(2) Service Bridge. The steel beams are surface corroded and the center piers are rusting where they have been in contact with water. The upstream edge of the concrete deck is spalled and eroded.

(3) Low Level Outlet. A crack runs the full height of the low-level outlet valve pit on both sides. The steel stairs in the pit are badly corroded, and the downstream end of the outlet pipe is covered with debris and could not be seen.

c. Reservoir Area. The watershed above the lake is gently to moderately sloping and wooded. Morsetown Road runs parallel to the east edge of the reservoir. The reservoir slopes appear to be stable. No evidence of significant sedimentation was observed in the reservoir. Several trees are overhanging the pond at the approach to the spillway at the left abutment.

d. Downstream Channel. The channel downstream from the spillway runs along the toe of the embankment for about 50 feet before making a turn downstream. Considerable erosion has occurred on the right and left banks of the channel immediately downstream of the spillway for a distance of 100 to 200 feet. The channel bottom is in soil and there is limited erosion protection on the side of the channel adjacent to the toe.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

No formal operating procedures were disclosed.   Water level is
controlled as the situation dictates.

4.2 Maintenance of Dam

No formal maintenance procedures for the dam were disclosed.

4.3 Maintenance of Operating Facilities

No formal maintenance procedures for the operating facilities
were disclosed. The owner said that she opens the drawdown
line to lower the water level about 2 feet each fall and allows
spring freshets to refill the reservoir.

4.4 Warning System

No description of any warning system was found.

4.5 Evaluation of Operational Adequacy

Because of the lack of operation and maintenance procedures,
the remedial measures described in Section 7.2 should be
implemented as prescribed.

SECTION 5
HYDROLOGIC/HYDRAULIC

5.1 Evaluation of Features

a. **Design Data.** Because no hydrologic or hydraulic data were revealed, an evaluation could not be performed.

b. **Experience Data.** No experience data were found.

c. **Visual Inspection.** The ogee spillway is, in general, in good condition with minor crest spalling and a wet spot on the ogee face. The right downstream training wall of the spillway has collapsed. The owner states that this big block of concrete now serves in part as an energy dissipator on the right side. However, the embankment is exposed and is ravelling behind the overturned wingwall. Vertical cracks were noted in the walls of the valve box, and its steel access ladder was badly corroded. The downstream outlet of the drawdown pipe was covered with debris and the outlet was not observed. The downstream channel empties into a small dammed pond about 100 yards downstream of the dam. The channel downstream from this low dam runs through a 3 x 4 foot box culvert under Morsetown Road and empties into a second small pond. Several houses have their first floor 6 feet above the normal water surface of this second pond.

d. **Carpi Lake Dam Overtopping Potential.** The hydraulic/hydrologic evaluation for the dam is based on a selected Spillway Design Flood (SDF) equal to one-half the probable maximum flood (PMF) in accordance with the range of test floods given in the evaluation guidelines for dams classified as significant hazard and small in size. The PMF was determined by application of the SCS dimensionless unit hydrograph to a 24-hour probable maximum precipitation of 22.0 inches. Hydrologic computations are given in Appendix 3.

The one-half PMF peak inflow to the reservoir is 870 cfs. The routed, one-half PMF discharge from the reservoir is 637 cfs.

The minimum elevation of the top of dam allows 1.7 feet of depth above the spillway. Under this head the total spillway capacity is 205 cfs, which is capable of passing 46 percent of the selected SDF inflow hydrograph. Thus the spillway is considered inadequate.

Flood routing calculations indicate that Carpi Lake Dam will be overtopped for 3 hours to a maximum depth of 0.9 foot under one-half PMF conditions.

e. **Drawdown Capability.** The 12-inch low-level outlet is capable of dewatering the dam in about 4 days, assuming no inflow; this is considered adequate.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

The presence of a dense growth of trees, vines, miscellaneous debris, and brush on the downstream slope of the embankment makes it impossible to make an adequate visual inspection of the embankment.

Trees growing on the embankment and in the area downstream of the toe may blow over and pull out their roots, or they may die with the result that the roots rot. Either of these events may result in serious seepage and erosion problems.

The collapse of the right concrete spillway training wall and adjacent erosion along the embankment toe that is due to the flow of water in the discharge channel could lead to a breach of the embankment and could also contribute to stability problems in the spillway structure.

The pedestrian path to the left of the spillway, mostly bare of vegetation from the crest to the downstream toe of the embankment, is susceptible to additional erosion and consequent damage to the embankment due to both runoff of rainfall and, if it should occur, overtopping.

The crest of the dam is uneven. Although the cause of the unevenness cannot be determined on the basis of visual inspection alone, it may be a sign of a potential stability problem. The soft, wet area and standing water at the downstream toe of the dam may be indicative of seepage through and under the dam which, if not properly controlled, could lead to failure of the dam by piping or sloughing of the downstream slope.

The deteriorating concrete in the spillway and the cracks in the valve pit box (because it is on the core wall) could contribute to stability problems if allowed to advance.

Serious erosion of the upstream slope of the dam at and above the waterline, if allowed to continue, could result in eventual breaching of the embankment.

6.2 Design and Construction Data

No design or construction data pertinent to the structural stability of the dam are available.

6.3 Operating Records

No operating records pertinent to the structural stability of the dam were available.

6.4 Post-Construction Changes

No record of post-construction changes was available.

6.5 Seismic Stability

This dam is in Seismic Zone 1. According to the Recommended Guidelines, dams located in Seismic Zone 1 "may be assumed to present no hazard from earthquake provided static stability conditions are satisfactory and conventional safety margins exist." The observations made during the visual inspection provided an indication of unstable embankments as mentioned in Section 6.1. However, because no data are available concerning the engineering properties of the embankment and foundation materials for this dam or the condition at the base of the core wall, it is not possible to make an engineering evaluation of the stability of the slope or the factor of safety under static conditions.

SECTION 7
ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. Carpi Dam is approximately 50 years old and is in poor condition.

b. Adequacy of Information. The information available is such that the assessment of the dam must be based primarily on the results of the visual inspection.

c. Urgency. The recommendations made in 7.2.a and 7.2.b should be implemented by the owner as prescribed.

d. Necessity for Additional Data/Evaluation. The information available from the visual inspection is adequate to identify the potential problems which are listed in 7.2.a. These problems require the attention of a professional engineer who will have to make additional engineering studies to design or specify remedial measures to rectify the problems. If left unattended, the problems could lead to failure of the dam.

7.2 Recommendations/Remedial Measures

a. Recommendations.

The owner should engage a professional engineer qualified in the design and construction of dams to accomplish the following in the near future:

(1) Evaluate further the adequacy of the spillway capacity and design and oversee construction of additional capacity if found necessary.

(2) Investigate the cause of wet, soft areas and standing water at the downstream toe of the dam.

(3) Investigate the uneven condition of the dam crest and design or specify measures to correct this condition.

(4) Design or specify the repairs for the erosion of the upstream slope and oversee the placement of adequate erosion protection for the upstream slope of the dam.

(5) Specify and oversee removal of trees, brush and vines from the entire embankment.

(6) Design and oversee replacement of the collapsed right, downstream concrete spillway training wingwall.

(7) Design and oversee the placement of adequate erosion protection along the toe of the embankment adjacent to the discharge channel.

(8) Design and oversee repairs to deteriorated concrete on the spillway and low-level outlet valve pit.

b. Alternatives. No alternative measures are recommended unless the owner determines that the reservoir is no longer required. In that case, the dam may be breached.

c. Operating and Maintenance Procedures.

The owner should accomplish the following soon:

(1) Start a program of periodically checking the condition of the dam and monitoring the wet area along the toe of the downstream slope.

(2) Develop an emergency action plan which outlines actions taken by the owner to minimize downstream effects of an emergency at the dam.

(3) Remove trees and brush for a distance of 25 feet downstream from the toe of the dam or to the property line, whichever is less.

(4) Control trespassing on the dam.

In the near future:

(1) Re-establish and maintain grassy vegetation on the dam after removal of trees, brush, vines and repair of eroded areas on the dam.

(2) Clear trees and brush on either side of the spillway discharge channel for distance of 100 feet from the spillway crest or to the limits of the property line whichever is less.

(3) Clean and paint all rusted steel on the service bridge.

(4) Repair or replace steel ladder in valve pit.

(5) Develop written operating procedures and a periodic maintenance plan, to ensure the safety of the dam.

-13-

CARPI LAKE

TOE OF SLOPE
12" PIPE
SPILLWAY
20'
CONCRETE COREWALL
VALVE WELL
5
25
TOE OF SLOPE
LARGE BOULDERS
CHANNEL

PLAN

300'
EI.938.5'
BRIDGE DECK
EI.938.8'
COREWALL
EI.937.4'
SPILLWAY CREST
EI.935.7'
ASSUMED BASE OF COREWALL
CONCRETE ABUTMENTS
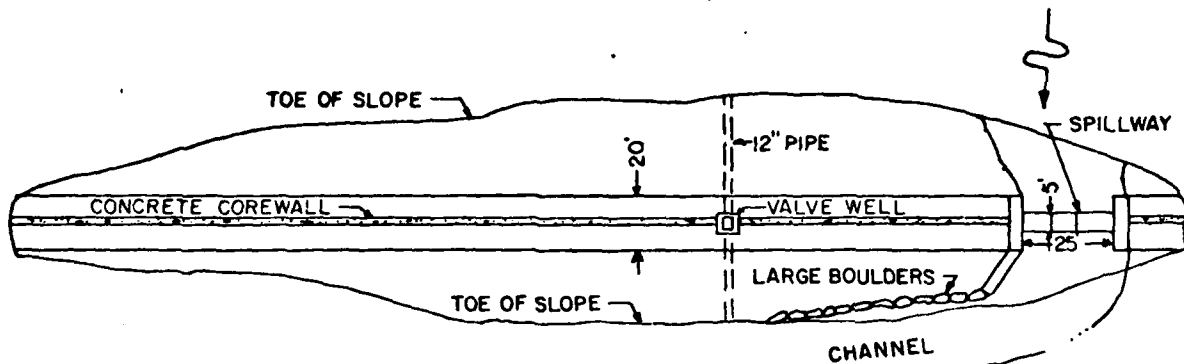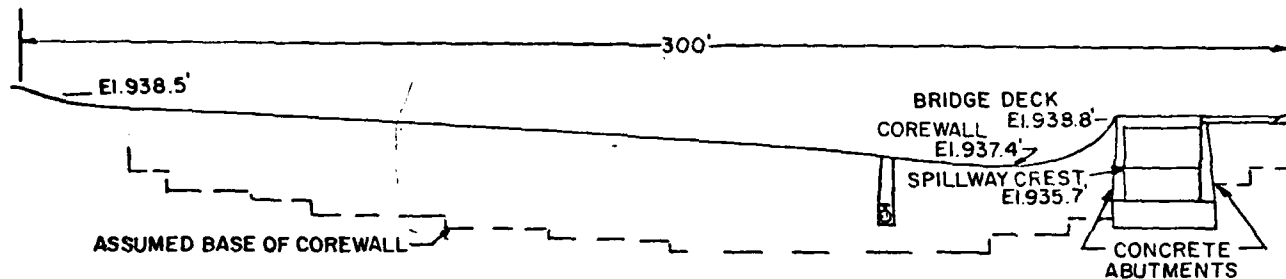
ELEVATION

12" C.I.P.
INVERT EI.927.2'

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CARPI LAKE DAM

TRIB. TO MORSETOWN BROOK	NEW JERSEY
	SCALE NOT TO SCALE
	DATE JUNE 1981

FIGURE - 1

DAM LOCATION

SCALE IN MILES

0   4   8

MAP BASED ON STATE OF NEW JERSEY
OFFICIAL MAP & GUIDE.

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NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

CARPI LAKE DAM
LOCATION MAP

TRIB. TO MORSETOWN BROOK	NEW JERSEY
	SCALE: 1" = 4 Miles Approx.
	DATE: JUNE 1981

FIGURE

APPENDIX 1

CHECK LIST

VISUAL INSPECTION

CARPI LAKE DAM

Check List
Visual Inspection
Phase 1

Name Dam ___Carpi Lake Dam___ County ___Passaic___ State ___NJ (00192)___ Coordinators ___NJDEP___

Date(s) Inspection ___2/17/81___ Weather' ___Sunny, warm___ Temperature ___52°___
                    ___4/23/81___   ___Rain___   ___55°___

Pool Elevation at Time of Inspection ___934.7'___ NGVD Tailwater at Time of Inspection ___None___ NGVD

Inspection Personnel:

W. Guinan _____ K. Stuart _____ C. Plaud _____

S. Gilman _____ D. Deane _____

R. Murdock _____

R. Murdock/K. Stuart _____ Recorder

Owner did not accompany inspection party

1-1

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete in fair condition. Erosion of concrete surface in vicinity of 2-inch notch is eroded 3/4-inch exposing coarse aggregate. Face of spillway is surface eroded exposing coarse aggregate. Minor wet spot noted near bottom left of center.	Repair concrete
APPROACH CHANNEL	Clear – unobstructed	
DISCHARGE CHANNEL	Brush, trees. Training wall on right side d/s collapsed into channel about 4 years ago. Natural stream bed, erosion on both banks.	Repair or replace training wall
BRIDGE AND PIERS OVER SPILLWAY	Concrete deck in fair condition. Piers in fair condition. Deck in good condition except for spalling and erosion on u/s edge. Abutments – both u/s faces are eroded and spalled at the water line and beneath the deck. Beams – Surface corroded – no paint. Columns – Painted but rusting where in contact with water – other minor areas of corrosion. Railing – fair – u/s railing is loose.	Repair deteriorated concrete. Clean and paint rusting steel. Repair railings.

1-2

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Sloughing on upstream face, some trees, sloughing and erosion on downstream slope, extensive vegetation, difficult to inspect slope thoroughly.	Clear vegetation; repair erosion and provide adequate erosion protection.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal - Good Vertical - Slight undulation of surface near downstream edge of crest.	Investigate cause and correct undulation.
RIPRAP FAILURES	Many areas of displaced riprap along crest.	Repair riprap.

1-3

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMENDATIONS
RAILINGS	None apparent	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Erosion on both sides of spillway, right concrete spillway training wall collapsed downstream of spillway.	
ANY NOTICEABLE SEEPAGE	Entire toe wet and soggy, standing water evident, no seepage observed, may be obscured by extensive vegetation.	
STAFF GAGE AND RECORDER	None apparent	
DRAINS	None apparent	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Crack running full height of concrete valve pit, both sides. Steel steps in chamber are badly corroded.	Repair cracks Replace steps
INTAKE STRUCTURE	Under ice - not visible	
OUTLET PIPE	Not visible, covered by brush and rocks, operated recently.	Remove brush and restore end of pipe.
OUTLET CHANNEL	Brush	
EMERGENCY GATE	Approximate 10-inch gate valve with hand wheel.	Verify operating capability of valve.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gradual to steeply sloped, some open fields.	
SEDIMENTATION	No appreciable sedimentation noted in reservoir.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Brush filled, trees 6 inches to 8 inches	Cut trees/brush
SLOPES	Gentle slopes	
APPROXIMATE NO. OF HOMES AND POPULATION	One house - 9-ft sill One house - 12-ft sill 2 Houses - 3 ft above d/s pond d/s bridge - 4 ft deep - 4.5 ft wide - 34 ft long	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	An undated plan, #22-129, is on file at the New Jersey Department of Environmental Protection, Prospect Street, Trenton, New Jersey 08625.
REGIONAL VICINITY MAP	Prepared for this report
CONSTRUCTION HISTORY	None found
TYPICAL SECTIONS OF DAM	See "PLAN OF DAM" above
HYDROLOGIC/HYDRAULIC DATA	None found
OUTLETS - PLAN	
- DETAILS	None found
- CONSTRAINTS	
- DISCHARGE RATINGS	
RAINFALL/RESERVOIR RECORDS	None found

1-8

ITEM	REMARKS
DESIGN REPORTS	None found
GEOLOGY REPORTS	None found
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None found
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None found
POST-CONSTRUCTION SURVEYS OF DAM	None found
BORROW SOURCES	Unknown

1-9

ITEM	REMARKS
MONITORING SYSTEMS	None found
MODIFICATIONS	None found
HIGH POOL RECORDS	None found
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None found
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None found
MAINTENANCE OPERATION RECORDS	None found

ITEMS	REMARKS
SPILLWAY PLAN	See "PLAN OF DAM"
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None found

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: .28 square miles, woods

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 935.7' NGVD (57.2 acre-
feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): Not applicable

ELEVATION MAXIMUM TEST FLOOD POOL: 938.4' NGVD

ELEVATION TOP DAM: 937.4' NGVD

SPILLWAY CREST: Overflow, low notch in weir

    a.   Elevation 935.7' NGVD

    b.   Type Ogee

    c.   Width 16 feet

    d.   Length 25 feet

    e.   Location Spillover Right end of dam

    f.   Number and Type of Gates None

OUTLET WORKS: 1-12" C.I.P., Invert at 927.2' NGVD

HYDROMETEOROLOGICAL GAGES: None

MAXIMUM NON-DAMAGING DISCHARGE: 205 cfs

APPENDIX 2

PHOTOGRAPHS

CARPI LAKE DAM

Bridge deck slab, core wall and valve box, looking from
left (west) to right (east) along axis of dam.

Overflow spillway downstream face.

April 23, 1981

Erosion and spalling of concrete spillway training
wall below bridge slab on upstream left side of dam.
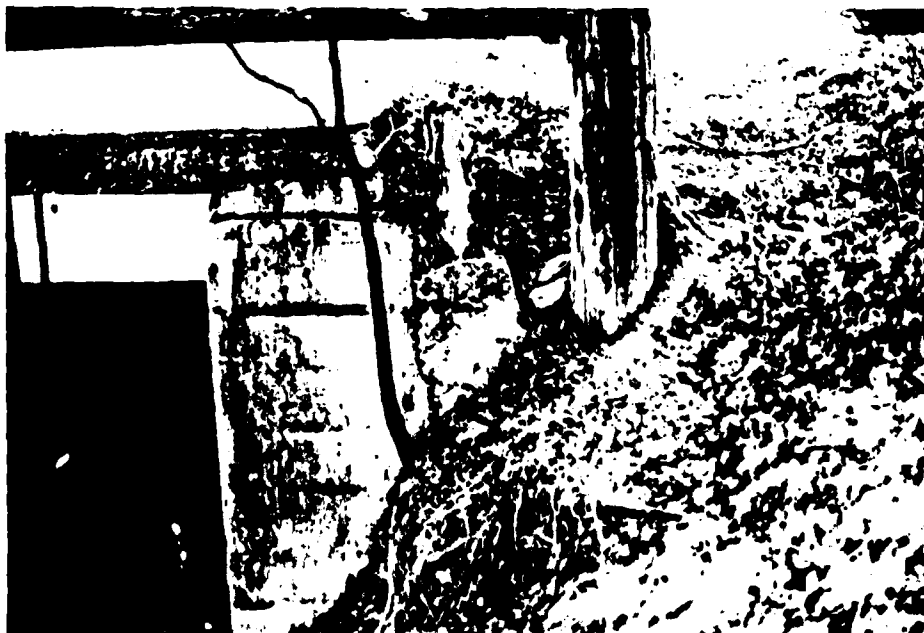
April 23, 1981

Erosion adjacent to spillway, downstream left side.

April 23, 1981

Ogee spillway contact with left training wall. Note
crack across face near bottom and wet spot near left
bottom of photograph.
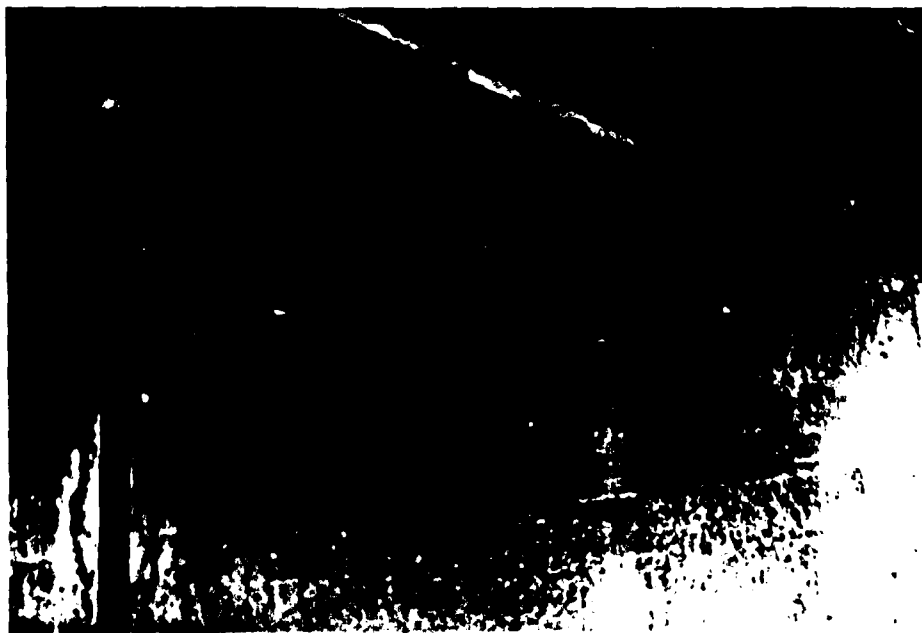
April 23, 1981

Beam anchorage under deck.

2-3
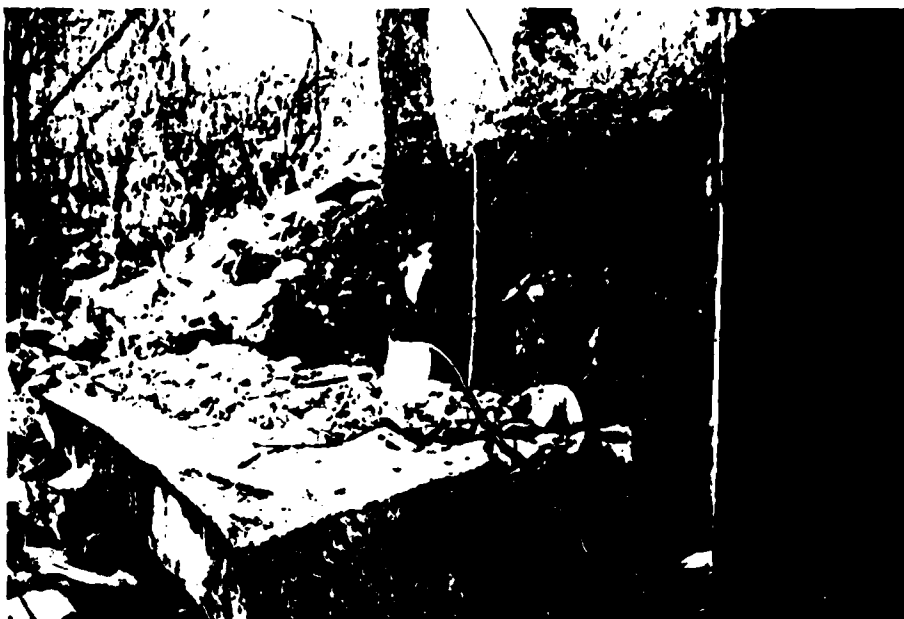
April 23, 1981

Collapsed right training wingwall of spillway;
rule extended 6 feet.

April 23, 1981

Undercutting at toe of slope caused by the close proximity
of discharge channel; looking upstream.

April 23, 1981

Crest is slightly undulating in elevation.
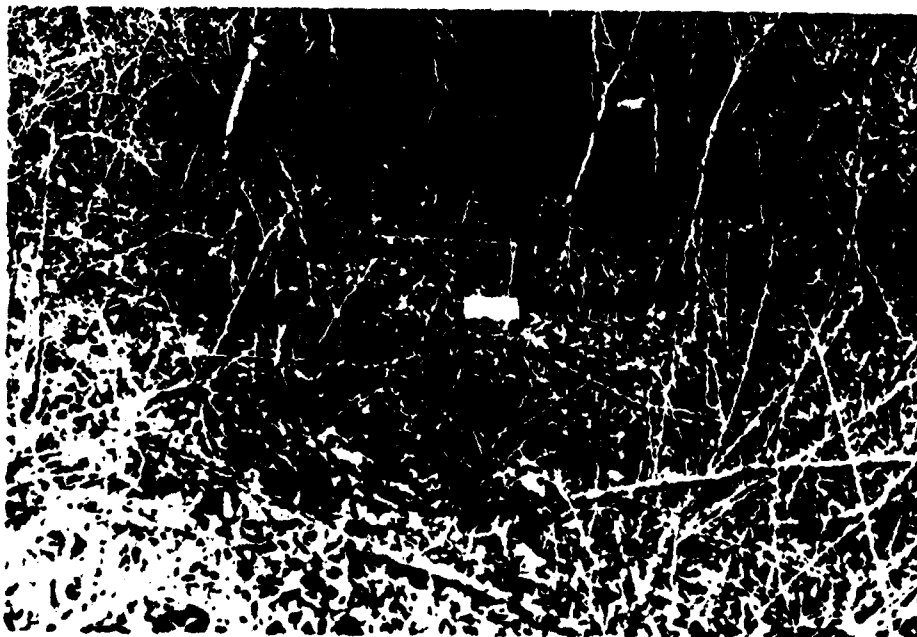
April 23, 1981

Large berm on downstream slope: may be due to
former sloughing.

April 23, 1981

Ground wet and soggy with some standing water along
toe of slope.
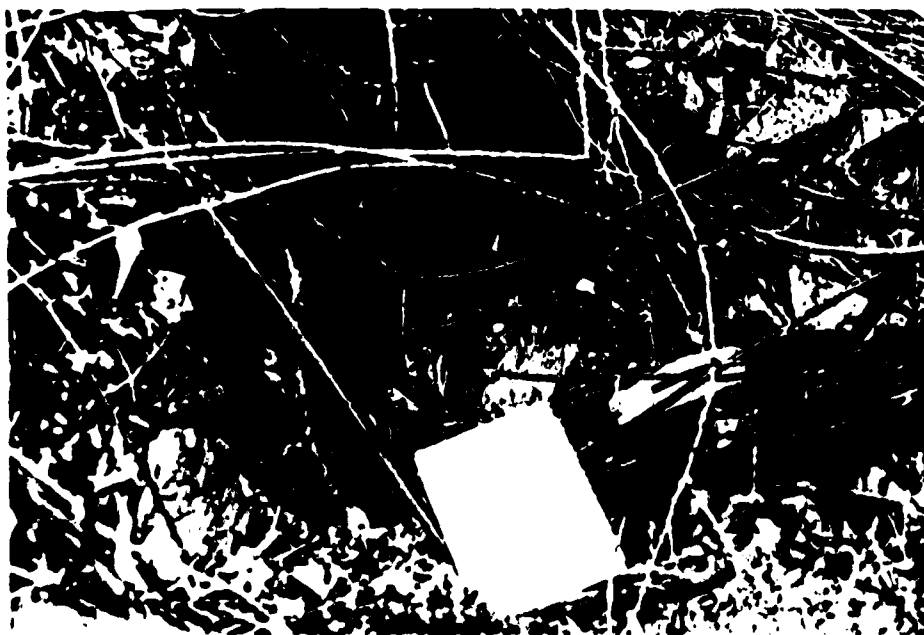
April 23, 1981

Large erosion feature at the toe of slope 3 feet
wide, 4 feet along slope, and 2 feet deep.

APPENDIX 3

<u>HYDROLOGIC COMPUTATIONS</u>

CARPI LAKE DAM

DAM

UPSTREAM DRAINAGE AREA
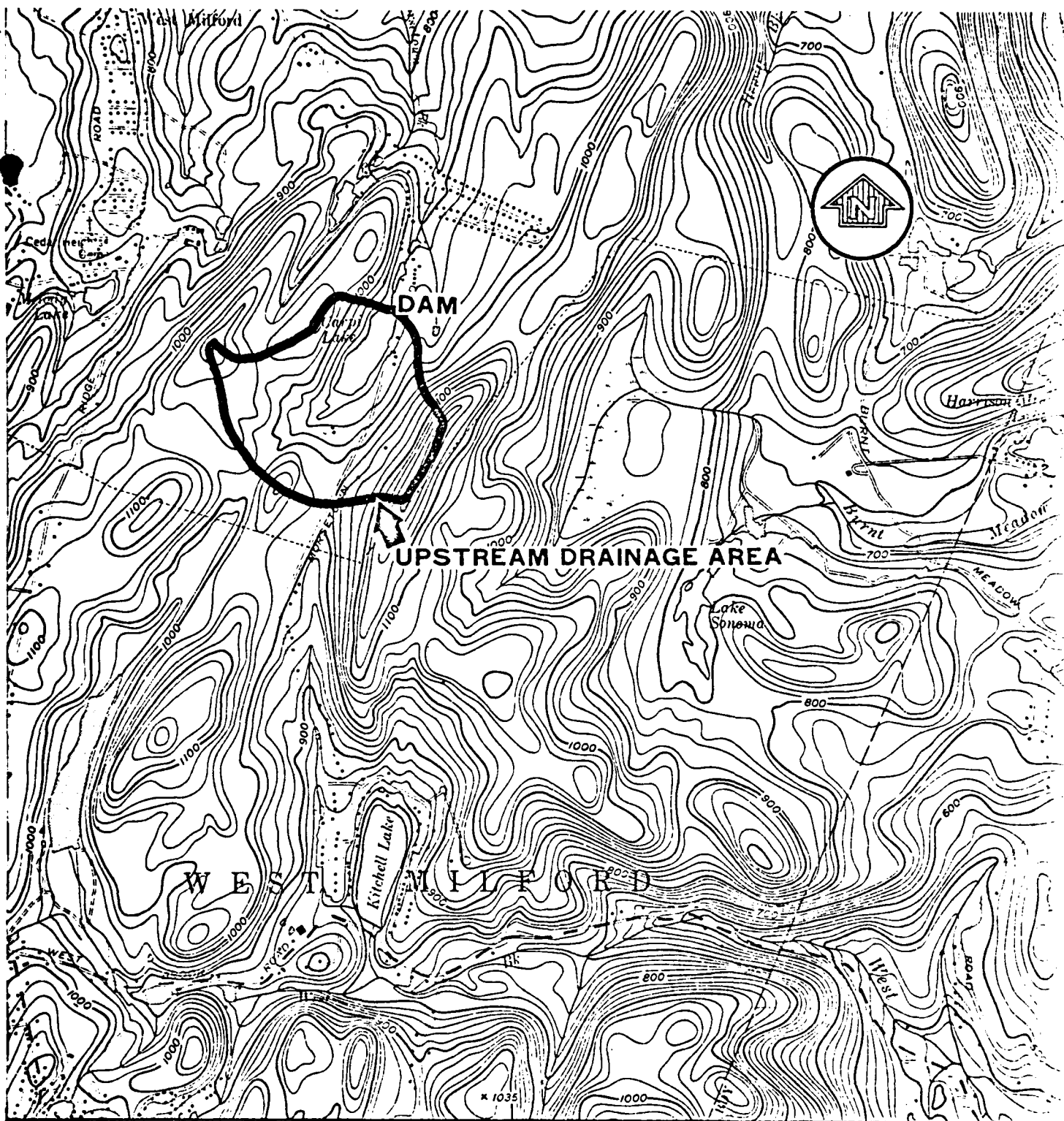
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	SCALE IN MILES
CARPI LAKE DAM WEST MILFORD TOWNSHIP, NEW JERSEY **REGIONAL VICINITY MAP** JUNE 1981 DEPARTMENT OF THE ARMY PHILADELPHIA DISTRICT, CORPS OF ENGINEERS PHILADELPHIA, PENNSYLVANIA Anderson-Nichols & Company, Inc. BOSTON, MA.	0 1/2 MAP BASED ON U.S.G.S. 7.5 MINUTE QUADRANGLE SHEET WANAQUE, N.J. 1954, REVISED 1971.
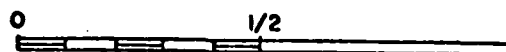
SQUARES 1/4 IN. SCALE

Time of Concentration

① Texas Highway Method

all overland - longest flowpath = 2,300 ft.

$$Slope = \frac{1100 - 935}{2,300} = 0.072 = 7.2\%$$

velocity = 2.0 fps for woodlands

$$Time = \frac{2,300}{2.0} = 1150 \, sec = 0.32 \, hours$$

② Soil and Water Conservation Method

$$L = 0.6 \, T_c = \frac{\ell^{0.8} \left(s+1 \right)^{1.67}}{9,000 \; y^{0.5}} \qquad S = \frac{1,000 - CN}{10}$$

$y = 7.2\%$

$\ell = 2,300$

$CN = 70$ for good condition woods, soil group C $\longrightarrow S = 4.29$

$$T_c = 0.55 \, hours$$

③ Weston, or SCS T.R. #55 Method

all overland.   Slope = 7.2%, length = 2,300 ft

From T.R. #55 graph, $v = 0.7$ fps

$$Time = \frac{2,300}{0.7} = 3,286 \, sec = 0.91 \, hours$$

④ Kerby Method

all overland . $T_c = 0.83 \left(\frac{N\ell}{\sqrt{s}} \right)^{0.467}$. $N = 0.7$, $L = 2,300$ ft, $S = 0.072$

$$T_c = 0.83 \left(\frac{0.7 \, (2,300)}{\sqrt{0.072}} \right)^{0.467} = 48.2 \, min = 0.80 \, hours$$

Average of 4 methods: $T_c = \dfrac{0.32 + 0.55 + 0.91 + 0.80}{4} = 0.645$ hours

$l_{ag} = 0.6\, T_c = 0.387$ hrs.

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Sheet No. __3__ of __12__
Date __6/29/81__
Computed __CG__
Checked __LP__

JOB NO.

SQUARES 1/4 IN. SCALE

Stage Versus Discharge

A hydraulic profile of Carpi Lake Dam is given on page 4. E = water surface elevation (feet above NGVD). Numbers in circles (①, ②, etc.) refer to sections numbered on page 4.

Spillway (section ③):

From 935.7 to about 938.5 weir flow, $Q = CLH^{3/2}$, $C = 3.7$ for ogee

$$Q = 3.7(25)(E-935.7)^{3/2}$$

Above 938.5 or so, the spillway becomes an orifice with a broad-crested weir above.

$$Q = Q_{orifice} + Q_{B.C.\ weir}$$

$$= C_{orifice}\, A_{orifice} \sqrt{2g H_{orifice}} + C_{weir}\, L\, H_{weir}^{3/2}$$

$C_{orifice} = 0.61$ $C_{weir} = 3.0$
$A_{orifice} = 25(2.4) = 60\,ft^2$ $L = 25'$
$H_{orifice} = E - 936.9$ $H_{weir} = E - 938.8$

$$Q = 0.61\,(60)\,\sqrt{64.4}\,(E-936.9)^{1/2} + 3.0\,(25)(E-938.8)^{3/2}$$

$$= 293.7\,(E-936.9)^{1/2} + 3\,(25)(E-938.8)^{3/2}$$

Top of Dam (sections ②, ④, ⑤, ⑥, ⑦, ⑧):

We will get stage vs. Q at 927.2, 935.7, 936, 936.5, 937, 937.4, 938, 938.5, 939, 939.5, $C = 2.7$ for all top of dam sections

side slope

top of spillway

top of dam

—— top of dam ——

side slope

30' | 25' | 45' | 50' | 50' | 50' | 50' | 50' | 5'/1

⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

939.3
938.8
938.1
939.9
932.1
937.4
937.6
937.7
937.7
937.9
938.5
935.7
935.7

Bridge

Elevation (Ft. above NGVD)

940
938
936
932
934

⊗ 12" C.I.P., invert at 927.2

Section ② is a 60H:1V sloping weir with avg. height 939.05, one end at 938.8, and the other at 939.3. Length = 30 ft.

Section ④ is a 45' long 32.1H:1V sloping weir with avg. height 938.1, one end at 937.4, and the other at 938.8

Section ⑤ is a 50' 250 H:1V sloping weir, avg. ht. 937.5, ends 937.4 and 937.6

Section ⑥ is a 50' 500H:1V sloping weir, avg. ht. 937.65, ends 937.6 and 937.

Section ⑦ is a 50' 250 H:1V sloping weir, avg. ht. 937.8, ends 937.7 and 937.9

Section ⑧ is a 50' 83.3H:1V sloping weir, avg. ht. 938.2, ends 937.9 and 938.5

for a paritially submerged sloping weir:
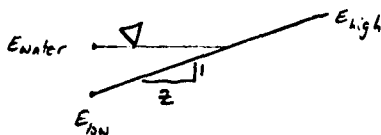
$$Q = C\, L_{submerged}\, H_{avg}^{3/2}$$

$$C_{submerged} = z\,(E_{water} - E_{low})$$

$$H_{avg} = \frac{0 + (E_{water} - E_{low})}{2} = 0.5(E_{water} - E_{low})$$

$$Q = C\,(z)(E_{water} - E_{low})\,(0.5(E_{water} - E_{low}))^{3/2}$$

for a fully submerged sloping weir:
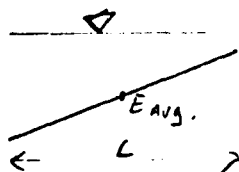
$$Q = C L\, H_{avg}^{3/2} = C L\,(E_{water} - E_{avg})^{3/2}$$

for stage of 927.2, 935.2, 936, 936.5, 937, 937.4: $Q = 0.0$

for stage of 938-938.5: $Q = 2.7\,(32.1)(E-937.4)^{④}(0.5(E-937.4))^{3/2} + 2.7\,(50)(E-937.5)^{3/2}\,^{⑤}$

$$+\ 2.7\,(50)(E-937.65)^{3/2}\,^{⑥} + 2.7\,(50)(E-937.8)^{3/2}\,^{⑦}$$

$$+\ 2.7\,(83.3)(E-937.9)(0.5(E-937.9))^{3/2}\,^{⑧}$$

for stage of 939: $Q = 2.7\,(60)(E-938.8)(0.5(E-938.8))^{3/2}\,^{②} + 2.7\,(45)(E-938.1)\,^{④}$

$$+\ 2.7\,(50)(E-937.5)^{3/2}\,^{⑤} + 2.7\,(50)(E-937.65)^{3/2}\,^{⑥} + 2.7\,(50)(E-937.8)^{3/2}\,^{⑦} + 2.7\,(50)(E-93\ ^{⑧}$$

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JOB NO.

SQUARES 1/4 IN. SCALE

for a stage of 939.5 : $Q = 2.7(30)(E-939.05)^{3/2} + 2.7(45)(E-937.1)^{3/2}$

$+ 2.7(50)(E-937.5)^{3/2} + 2.7(50)(E-937.65)^{3/2} + 2.7(50)(E-937.8)^{3}$

$+ 2.7(50)(E-938.2)^{3/2}$

Side Slopes (sections ① and ⑨): C = 2.6

for 927.2 - 938.5, Q = 0.0

for 939.0 $Q = 2.6(15)(E-938.5)(0.5(E-938.5))^{3/2}$

for 939.5 $Q = 2.6(5)(E-939.3)(0.5(E-939.3))^{3/2} + 2.6(15)(E-938.5)(0.5(E-938.5))^{3/2}$

Elevation (Ft. above NGVD)	Description	Q spillway (cfs)	Q Top of Dam (cfs)	Q side slopes (cfs)	Q Total (cfs)
927.2	invert of blow-off, 0 storage	0	0	0	0
935.7	spillway crest	0	0	0	0
936.0		15	0	0	15
936.5		66	0	0	66
937.0		137	0	0	137
937.4	top of dam	205	0	0	205
938.0		323	97	0	420
938.5		372	381	0	753
939.0		432	839	2	1,273
939.5		518	1,447	14	1,979

46 0782

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Carp Lake Dam

Stage Vs. Discharge

Anco

6/29/8?

TCG:kkS

Curve labels: Spillway, Total + twin 3' dia. side sluices, side sluices

X-axis: Discharge (cfs) — 0, 500, 1,000, 1,500, 2,000

Y-axis: Elevation (Ft. above MSL) — 935, 936, 937, 938, 939

Anderson-Nichols & Company, Inc.   Subject _Carpi Lake Dam_

Sheet No. _8_ of _12_
Date _6/29/81_
Computed _TCG_
Checked _KW_

JOB NO.

SQUARES 1/4 IN. SCALE

Stage Vs. Storage

Surface area at normal pool, 935.7 ft NGVD = 14.3 acres. The surface area at 940 ft. NGVD = 20.1 ac. Assume: 4 ft avg. depth (→ normal storage = 4 (14.3) = 57.2 ac-ft); 0 storage at 927.2; linear increase in surface area with elevation

Elevation (Ft. above NGVD)	ΔH (Feet)	Surface Area (Acres)	Avg. S.A. (Acres)	Incremental Storage (Ac-Ft)	Cumulative Storage (Ac-Ft)
927.2		0			0
	8.5		—	—	
935.7		14.3			57.2
	0.3		14.5	4.4	
936.0		14.7			61.6
	0.5		15.05	7.5	
936.5		15.4			69.1
	0.5		15.7	7.8	
937.0		16.0			76.9
	0.4		16.35	6.5	
937.4		16.7			83.4
	0.6		17.05	10.2	
938.0		17.4			93.6
	0.5		17.75	8.9	
938.5		18.1			102.5
	0.5		18.45	9.2	
939.0		18.8			111.7
	0.5		19.1	9.6	
939.5		19.4			121.3

Carpi Lake Dam

Stage Vs. Storage

P. 9 of 12

Elevation (Ft. above NGVD) vs. Storage (Ac-Ft)

JOB NO.

SQUARES
1/4 IN. SCALE

Overtopping Analysis

Spillway capacity at top of dam
= 205 cfs

Outflow (cfs)
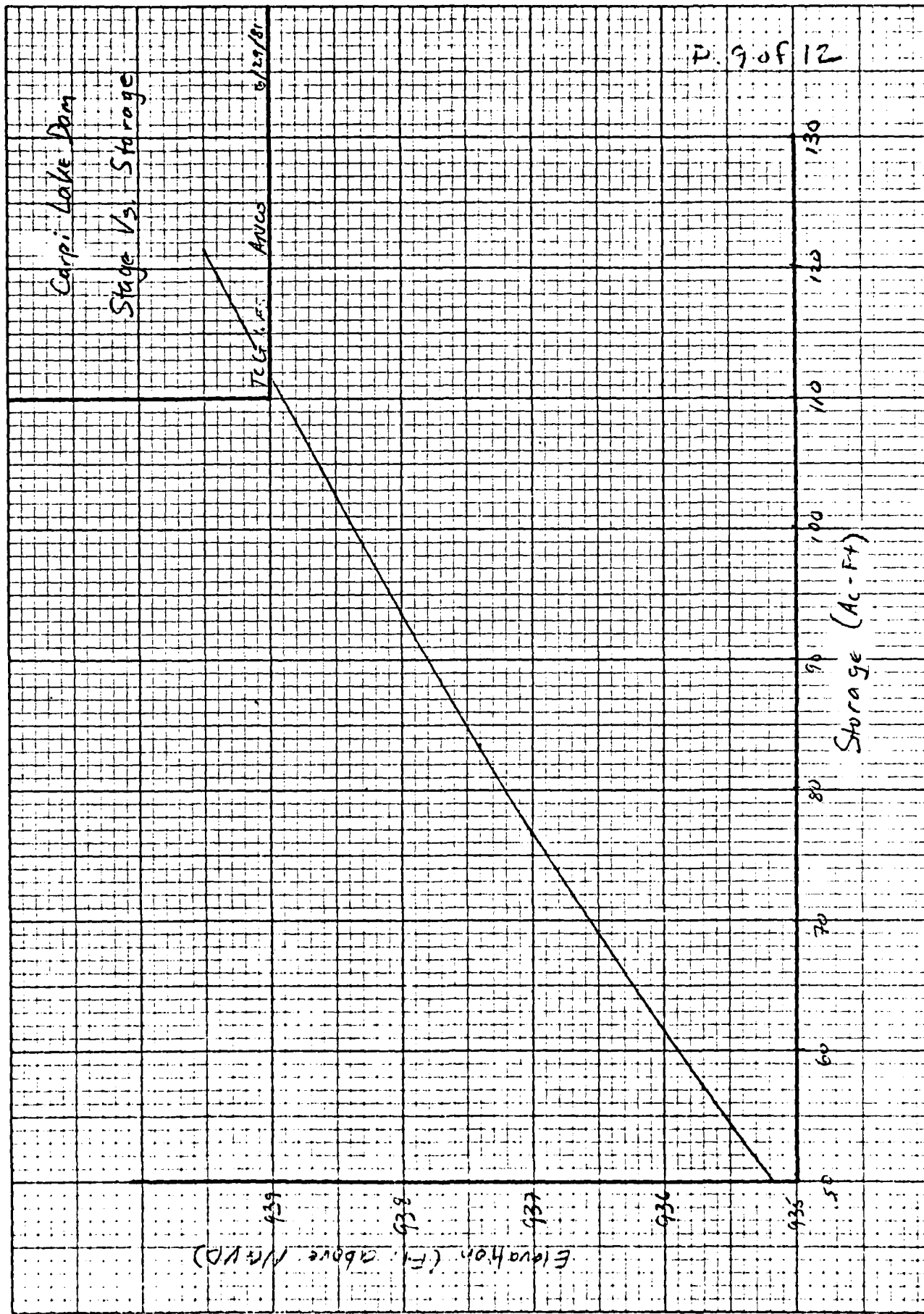
SQUARES 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
1/4 IN. SCALE

Drawdown Time

① Plans show one 12" pipe, invert at 927.2. Assume inlet control,

$$Q = C A \sqrt{2g'} \sqrt{H'} ; \quad C = 0.61, \quad A = \frac{\pi}{4}, \quad H = E - 927.7$$

$$Q = 0.61 \left(\frac{\pi}{4}\right) \sqrt{64.4} \, (E - 927.7)^{1/2} = 3.84 \, (E - 927.7)^{\frac{1}{2}}$$

② For storage below the water surface, assume:

$$S = C_s h^N. \quad h = \text{height above 0 storage, } 927.2',$$

from p. 8:

	E	h	S
Point 1	935.7	8.5	57.2
Point 2	939.5	12.3	121.3

so $121.3 = C_s (12.3)^N$

$\ln 121.3 = \ln C_s + N \ln 12.3$

$\longrightarrow \ln C_s = 4.798 - N (2.51)$

and $57.2 = C_s (8.5)^N$

$\ln 57.2 = \ln C_s + N \ln 8.5$

substitute for $\ln C_s$ from above.

$4.047 = 4.798 - N (2.51) + (N)(2.140)$

$N = \dfrac{4.798 - 4.047}{2.51 - 2.14} = 2.03$

$\ln C_s = 4.798 - 2.03 (2.51) = -0.297$

$\longrightarrow C_s = 0.743$

so $S = 0.743 \, (E - 927.2)^{2.03}$

③ $\text{Ac-ft/day} = 1.98 \, Q_{Avg}$

④ $\text{Days} = \dfrac{\Delta S}{\text{Ac-ft/day}}$

Anderson-Nichols & Company, Inc.   Subject _Carpi Lake_   Sheet No. _12_ of _12_
Date _6/29/8_
Computed _____
Checked _____

JOB NO.

Elevation (Ft above NGVD)	Storage (Ac-Ft)	ΔS (Ac-Ft)	Q (CFS)	Q_{AVG} (CFS)	Ac-Ft per Day	Days
935.7	57.2		10.9			
		9.1		10.65	21.1	0.43
935	48.1		10.4			
		11.7		10.0	19.8	0.59
934	36.4		9.6			
		10.1		9.2	18.2	0.55
933	26.3		8.8			
		8.4		8.4	16.6	0.51
932	17.9		8.0			
		6.7		7.5	14.9	0.45
931	11.2		7.0			
		5.2		6.4	12.7	0.41
930	6.0		5.8			
		3.5		5.1	10.1	0.35
929	2.5		4.4			
		2.0		3.25	6.4	0.31
928	0.5		2.1			
		0.5		1.05	2.1	0.24
927.2	0.0		0			

$$\Sigma = 3.84 \; \text{Days}$$

APPENDIX 4

HEC-1 OUTPUT

CARPI LAKE DAM

```
LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

  1       ID    CARPI LAKE DAM
  2       ID    NEW JERSEY DAM NO. 192 - PASSAIC COUNTY - WEST HELFORD TOWNSHIP   TOM GOOCH   ANCO
  3       IT    ONE-HALF PMF FROM 24-HOUR PMP
  4       IO      5      0    300
  5
  6       JR    FLOW    0.5
  7
  8       KK    A1 CARPI LAKE INFLOW HYDROGRAPH
  9       KM    INFLOW FROM SCS UNIT GRAPH COMPUTATIONS
 10       BA    0.28
 11       BF    22.0    0.9      1
 12       PH             NO    113    123    132
 13       LU    0.387   0.1
 14
 15       KK    A2 ROUTE INFLOW HYDROGRAPH THROUGH CARPI LAKE
 16       RS    STOR   57.2   69.1   76.9   83.4   93.6  102.5  111.7  121.3
 17       SV    927.0  935.7  936.   937.   937.4  938.   938.5  939.   939.5
 18       SE    935.0   15.  936.5  937.   937.4  420.   753.5 1273.  1979.5
 19       SQ    935.7  936.7  937.   937.4  938.   938.5  939.
 20       SE    937.4    0.0    1.5
 21       SS    275.0
 22       SS
```

        CARPI LAKE DAM   OVERTOPPING ANALYSIS   TOM GOOCH   ANCO
        NEW JERSEY DAM NO. 192 PASSAIC COUNTY - WEST MELFORD TOWNSHIP
        ONE-HALF PMF FROM 24-HOUR PMP

5 IO   OUTPUT CONTROL VARIABLES
             IPRNT   2   PRINT CONTROL
             IPLOT   1   PLOT CONTROL
             QSCAL   0.   HYDROGRAPH PLOT SCALE
             DMSG   YES   PRINT DIAGNOSTIC MESSAGES

IT   HYDROGRAPH TIME DATA
             NMIN   5   MINUTES IN COMPUTATION INTERVAL
             IDATE   1 0000 STARTING DATE
             ITIME   0000   STARTING TIME
             NQ   300   NUMBER OF HYDROGRAPH ORDINATES
             NDDATE   2 0055 ENDING DATE
             NDTIME   0055   ENDING TIME

        COMPUTATION INTERVAL   0.08 HOURS
        TOTAL TIME BASE   24.92 HOURS

ENGLISH UNITS
        DRAINAGE AREA   SQUARE MILES
        PRECIPITATION DEPTH   INCHES
        LENGTH, ELEVATION   FEET
        FLOW   CUBIC FEET PER SECOND
        STORAGE VOLUME   ACRE-FEET
        SURFACE AREA   ACRES
        TEMPERATURE   DEGREES FAHRENHEIT

JP   MULTI-PLAN OPTION
             NPLAN   1   NUMBER OF PLANS

JR   MULTI-RATIO OPTION
             RATIOS OF RUNOFF
             0.50

*** ***

        ****
        *   A1   *   CARPI LAKE INFLOW HYDROGRAPH
7 KK   *************

        INFLOW FROM SCS UNIT GRAPH COMPUTATIONS

        SUBBASIN RUNOFF DATA

9 BA   SUBBASIN CHARACTERISTICS
             TAREA   0.24   SUBBASIN AREA

10 BF   BASE FLOW CHARACTERISTICS
             STRTQ   0.90   INITIAL FLOW
             QRCSN   0.90   BEGIN BASE FLOW RECESSION
             RTIOR   1.00000   RECESSION CONSTANT

PRECIPITATION DATA

11 PM - PROBABLE MAXIMUM STORM
    TRSPC   22.00   INDEX PRECIPITATION
    TRSDA   00.00   TRANSPOSITION COEFFICIENT
    TRSWD   0.24   TRANSPOSITION AREA
                  USE SWD DISTRIBUTION

PERCENT OF INDEX PRECIPITATION OCCURRING IN GIVEN TIME
6-HR   12-HR   24-HR   48-HR   72-HR   96-HR
113.0 123.0 132.0   0.0   0.0   0.0

12 LU - UNIFORM LOSS RATE
    STRTL   0.00   INITIAL LOSS RATE
    CNSTL   0.10   UNIFORM LOSS RATE
    RTIMP   0.0   PERCENT IMPERVIOUS AREA

13 UD - SCS DIMENSIONLESS UNITGRAPH
    TLAG   0.39   LAG

***

UNIT HYDROGRAPH
25 END-OF-PERIOD ORDINATES

30.	94.	198.	286.	315.	300.	256.	194.	134.	97.
73.	52.	38.	28.	20.	15.	11.	8.	6.	4.
3.	2.	1.	1.						

****

HYDROGRAPH AT STATION A1

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		0000	1	0.01	0.01	0.00	1.
1		0005	2	0.01	0.01	0.00	1.

DA	MON	HRMN	ORD	RAIN	LOSS	EXCESS	COMP Q
1		1230	151	0.17	0.01	0.16	209.
1		1235	152	0.17	0.01	0.16	245.

PEAK FLOW TIME
(CFS)   (HR)
1771.   15.92

MAXIMUM AVERAGE FLOW

	6-HR	24-HR	72-HR	24.92-HR
(INCHES)	18.917	20.598	20.675	20.675
(CFS)				
(AC-FT)	263.	309.	309.	309.

CUMULATIVE AREA = 0.28 SQ MI

HYDROGRAPH AT STATION A1
PLAN 1, RATIO = 0.50

DA MON HRMN ORD FLOW   DA MON HRMN ORD FLOW   DA MON HRMN ORD FLOW   DA MON HRMN ORD FLOW

PEAK FLOW TIME
(CFS)   (HR)
886.   15.92

	6-HR	MAXIMUM AVERAGE FLOW 24-HR	72-HR	24.92-HR
	285.	78.	75.	75.
(INCHES)	9.459	10.335	10.337	10.337
(AC-FT)	141.	154.	154.	154.

CUMULATIVE AREA = 0.28 SQ MI

****

14 KK   A2   ROUTE INFLOW HYDROGRAPH THROUGH CARPI LAKE

HYDROGRAPH ROUTING DATA

15 RS   STORAGE ROUTING
           NSTPS   1   NUMBER OF SUBREACHES
           ITYP   STOR   TYPE OF INITIAL CONDITION
           RSVRIC   57.20   INITIAL CONDITION
                     0.0   WORKING R AND D COEFFICIENT

STORAGE   0.0   57.2   61.6   69.1   76.9   83.4   93.6   102.5   111.7   121.3

16 SV

17 SE   ELEVATION   927.20   935.70   936.00   936.50   937.00   937.40   938.00   938.50   939.00   939.50

18 SQ   DISCHARGE   0.   0.   15.   66.   137.   205.   420.   753.   1273.   1979.

19 SE   ELEVATION   927.20   935.70   936.00   936.50   937.00   937.40   938.00   938.50   939.00   939.50

20 SS   SPILLWAY
        CREL   935.70   SPILLWAY CREST ELEVATION
        SPWID   25.00   SPILLWAY WIDTH
        COQW   3.90   WEIR COEFFICIENT
        EXPW   1.50   EXPONENT OF HEAD

21 ST   TOP OF DAM
        TOPEL   937.40   ELEVATION AT TOP OF DAM
        DAMWID 275.00   DAM WIDTH
        COQD   0.0   WEIR COEFFICIENT
        EXPD   1.50   EXPONENT OF HEAD

                                            ***

                          COMPUTED STORAGE-OUTFLOW CURVE

STORAGE   0.0   57.20   61.60   69.10   76.90   83.40   93.60   102.50   111.70   121.30

OUTFLOW   0.0   0.0   15.00   66.00   137.00 205.00 420.00 753.00   1273.00 1979.00

HYDROGRAPH AT STATION   A2
PLAN 1, RATIO = 0.50

```
1    0755  96          57.5   935.7  *****  1   1615 196   645.   99.6   938.3  ****  2   0035 296   12..   60.7  935.9
1    0800  98          57.6   935.7  *****  1   1620 197   618.   98.9   938.3  ****  2   0045 298   12..   60.7  935.9
1    0805  99          57.7   935.7  *****  1   1625 199   540.   97.9   938.2  ****  2   0050 299   11..   60.6  935.9
1    0810  99          57.8   935.7  *****  1   1630 199   538.   96.8   938.1  ****  2   0055 300         60.5  935.9
1    0815 100          57.9   935.7  *****  1   1635 200   496.   95.6
```

****

PEAK OUTFLOW IS   652. AT TIME   16.17 HOURS

```
PEAK FLOW    TIME                       MAXIMUM AVERAGE FLOW
 (CFS)       (HR)               6-HR       24-HR       72-HR
  652.       16.17    (CFS)     260.       10.76       10.73
                      (INCHES)  8.619      10.081      10.081
                      (AC-FT)   129.       151.        151.

EAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
 (AC-FT)      (HR)               6-HR       24-HR       72-HR
  100.        16.17             84.        66.         66.

PEAK STAGE    TIME                       MAXIMUM AVERAGE STAGE
 (FEET)       (HR)               6-HR       24-HR       72-HR
 938.35       16.17            937.28     936.27      936.25
```

CUMULATIVE AREA =   0.28 SQ MI

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

RATIOS APPLIED TO FLOWS

OPERATION	STATION	AREA	PLAN		RATIO 1
					0.50
HYDROGRAPH AT	A1	0.28	1	FLOW	886.
				TIME	15.92
ROUTED TO	A2	0.28	1	FLOW	652.
				TIME	16.17
				** PEAK STAGES IN FEET **	
			1	STAGE	938.35
				TIME	16.17

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION   A2

PLAN 1 ....

	ELEVATION STORAGE OUTFLOW	INITIAL VALUE 935.70 57. 0.		SPILLWAY CREST 935.57 57. 0.		TOP OF DAM 937.40 83. 205.	
RATIO OF PHF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	938.35	0.95	100.	652.	3.08	16.17	0.0

*** NORMAL END OF JOB ***

```
ID.......1.........2.........3.........4.........5.........6.........7.........8.........9.........10

ID    CARPI LAKE DAM       OVERTOPPING ANALYSIS       TOM GOOCH   ANCO
ID    NEW JERSEY DAM NO. 192 - PASSAIC COUNTY - WEST MILFORD TOWNSHIP
IT    0.1,0.25,3.5 MULTIPLES OF PMF FROM 24-HOUR PMP
IO             0       300
JR    FLOW    0.1     0.25    0.5

KK    A1 CARPI LAKE INFLOW HYDROGRAPH
KM       INFLOW FROM SCS UNIT GRAPH COMPUTATIONS
BA    0.28
BF    0.9       1               NO      111     123     133
PH    22.0
UD    0.387     0.1

KK    A2 ROUTE INFLOW HYDROGRAPH THROUGH CARPI LAKE
RS    1     STOR   57.2   69.1   76.9   83.4   93.6   102.5   111.7   121.3
SV    57.0   61.6   935.5   937.   937.4   938.   938.5   939.   939.5
SE    927.2   936.   915.   137.   205.   420.   753.   1273.   1979.5
SQ    935.7   936.5   936.5   937.   938.5   938.   939.   939.5
SW    927.2   936.   915.   137.   205.   420.   753.   1273.
SS    935.7   30.7   1.5
ST    937.4   275.0   0.0
```

```
*******************************
*  FLOOD HYDROGRAPH PACKAGE (HEC-1)  *
*         FEBRUARY 1981               *
*******************************
RUN DATE 08/10/81    TIME 10.43.37
*******************************
```

```
             CARPI LAKE DAM   OVERTOPPING ANALYSIS   TOM GOOCH   AVCO
             NEW JERSEY DAM NO.192 - PASSAIC COUNTY - WEST MILFORD TOWNSHIP
             0.1,0.25,0.5 MULTIPLES OF PMF FROM 24-HOUR PMP
```

5 IO   OUTPUT CONTROL VARIABLES
              IPRNT   3   PRINT CONTROL
              IPLOT   0   PLOT CONTROL
              QSCAL   HYDROGRAPH PLOT SCALE
              DMSG   YES   PRINT DIAGNOSTIC MESSAGES

7 IT   HYDROGRAPH TIME DATA
              NMIN   5   MINUTES IN COMPUTATION INTERVAL
              IDATE   1   STARTING DATE
              ITIME   0000   STARTING TIME
              NQ   300   NUMBER OF HYDROGRAPH ORDINATES
              NDDATE   2   ENDING DATE
              NDTIME   0055   ENDING TIME

        COMPUTATION INTERVAL   0.08 HOURS
        TOTAL TIME BASE   24.92 HOURS

  ENGLISH UNITS
        DRAINAGE AREA   SQUARE MILES
        PRECIPITATION DEPTH   INCHES
        LENGTH, ELEVATION   FEET
        FLOW   CUBIC FEET PER SECOND
        STORAGE VOLUME   ACRE-FEET
        SURFACE AREA   ACRES
        TEMPERATURE   DEGREES FAHRENHEIT

  JP   MULTI-PLAN OPTION
              NPLAN   1   NUMBER OF PLANS

  JR   MULTI-RATIO OPTION
              RATIOS OF RUNOFF
              0.10   0.25   0.50

```
*******************************
*                             *
*         A1                  *     CARPI LAKE INFLOW HYDROGRAPH
*                             *
*******************************
```

              INFLOW FROM SCS UNIT GRAPH COMPUTATIONS

9 BA   SUBBASIN RUNOFF DATA
              TAREA   0.28   SUBBASIN AREA

10 BF   BASE FLOW CHARACTERISTICS
              STRTQ   0.90   INITIAL FLOW
              QRCSN   0.30   BEGIN BASE FLOW RECESSION
              RTIOR 1.00000 RECESSION CONSTANT

  PRECIPITATION DATA

11 PM   PROBABLE MAXIMUM STORM
              PMS   22.00   INDEX PRECIPITATION
              TRSPC   0.40   TRANSPOSITION COEFFICIENT
              TRSCA   0.28   TRANSPOSITION AREA
              SWD   USE SWD DISTRIBUTION

```
PERCENT OF INDEX PRECIPITATION OCCURRING IN GIVEN TIME
        6-HR   12-HR   24-HR   48-HR   72-HR   96-HR
       111.0   123.0   133.0     0.0     0.0     0.0

UNIFORM LOSS RATE
    STRTL     0:00   INITIAL LOSS RATE
    CNSTL     0:0    UNIFORM LOSS RATE
    RTIMP            PERCENT IMPERVIOUS AREA

SCS DIMENSIONLESS UNITGRAPH
    TLAG   0.39   LAG

                         25 UNIT HYDROGRAPH
                            END-OF-PERIOD ORDINATES
       286.   315.   300.   256.        194.   134.    97.
        28.    20.    15.    11.          8.     6.     4.
       198.
        38.
         2.
        94.
        53.
         2.
        30.
        72.
         3.
```

12 LU

13 UD

***

```
PEAK FLOW     TIME
  (CFS)       (HR)                 MAXIMUM AVERAGE FLOW
  1740.       15.92        6-HR    24-HR    72-HR   24.92-HR
                (CFS)      560.     157.     151.     151.
              (INCHES)   18.582   20.804   20.808   20.808
              (AC-FT)      277.     311.     311.     311.

              CUMULATIVE AREA =    0.28 SQ MI
```

***

```
                 HYDROGRAPH AT STATION      A1
                 FOR PLAN 1. RATIO =  0.10
```

***

```
PEAK FLOW     TIME
  (CFS)       (HR)                 MAXIMUM AVERAGE FLOW
   174.       15.92        6-HR    24-HR    72-HR   24.92-HR
                (CFS)       56.      16.      15.      15.
              (INCHES)    1.858    2.080    2.081    2.081
              (AC-FT)       28.      31.      31.      31.

              CUMULATIVE AREA =    0.28 SQ MI
```

***

```
                 HYDROGRAPH AT STATION      A1
                 FOR PLAN 1. RATIO =  0.25
```

***

```
PEAK FLOW     TIME
  (CFS)       (HR)                 MAXIMUM AVERAGE FLOW
   435.       15.92        6-HR    24-HR    72-HR   24.92-HR
                (CFS)      140.      39.      38.      38.
              (INCHES)    4.645    5.201    5.202    5.202
              (AC-FT)       69.      78.      78.      78.

              CUMULATIVE AREA =    0.28 SQ MI
```

***

```
                 HYDROGRAPH AT STATION      A1
                 FOR PLAN 1. RATIO =  0.50
```

***

```
PEAK FLOW     TIME
  (CFS)       (HR)                 MAXIMUM AVERAGE FLOW
   870.       15.92        6-HR    24-HR    72-HR   24.92-HR
                (CFS)      260.      78.      75.      75.
              (INCHES)    9.291   10.402   10.404   10.404
              (AC-FT)      139.     155.     155.     155.

              CUMULATIVE AREA =    0.28 SQ MI
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

                    +++++++++++++++
20  KK              +++    A2     +++     ROUTE INFLOW HYDROGRAPH THROUGH CARPI LAKE
                    +++++++++++++++

15  KS      HYDROGRAPH ROUTING DATA

        STORAGE ROUTING
            NSTPS         1      NUMBER OF SUBREACHES
            ITYP   STOR          TYPE OF INITIAL CONDITION
            RSVRIC 57.20         INITIAL CONDITION
            X      0.0           WORKING R AND D COEFFICIENT

16  SV   STORAGE      0.0     57.2     61.6     69.1     76.9     83.4     93.6    102.5    111.7    121.3

17  SE   ELEVATION  927.20   935.70   936.00   936.50   937.00   937.40   938.00   938.50   939.00   939.50

18  SO   DISCHARGE    0.       0.      15.      66.     137.     205.     420.     753.    1273.    1979.

19  SE   ELEVATION  927.20   935.70   936.00   936.50   937.00   937.40   938.00   938.50   939.00   939.50

20  SS   SPILLWAY
             SCREL   935.70    SPILLWAY CREST ELEVATION
             SPWID    25.00    SPILLWAY WIDTH
             COOCW     3.70    WEIR COEFFICIENT
             EXPW      1.50    EXPONENT OF HEAD

21  ST   TOP OF DAM
             TOPEL   937.40    ELEVATION AT TOP OF DAM
             DAMWID  275.00    DAM WIDTH
             COOD      3.0     WEIR COEFFICIENT
             EXPD      1.50    EXPONENT OF HEAD

                                                     ***

                                     COMPUTED STORAGE-OUTFLOW CURVE
         STORAGE     0.0     57.20    61.60    69.10    76.90    83.40    93.60   102.50   111.70   121.30

         OUTFLOW     0.0      0.0     15.00    66.00   137.00   205.00   420.00   753.00  1273.00  1979.00

                                                     ***

                      HYDROGRAPH AT STATION      A2
                       FOR PLAN 1  RATIO = 0.16

***                                                  ***

           HYDROGRAPH AT TIME 16.50 HOURS      74. AT TIME 16.50 HOURS

                                      MAXIMUM AVERAGE FLOW
                              6-HR      24-HR     72-HR    24.92-HR
              (CFS)           46.       15.       14.       14.
              (INCHES)       1.521     1.951     1.951     1.951
              (AC-FT)         23.       29.       29.       29.

PEAK OUTFLOW IS      74. AT TIME 16.50 HOURS

PEAK FLOW    TIME
  (CFS)      (HR)
   74.      16.50
```

```
PEAK STORAGE   TIME              MAXIMUM AVERAGE STORAGE
(AC-FT)        (HR)         6-HR      24-HR    72-HR    24.92-HR
70.            16.50        66.       60.      60.      60.

PEAK STAGE     TIME              MAXIMUM AVERAGE STAGE
(FEET)         (HR)         6-HR      24-HR    72-HR    24.92-HR
936.56         16.50        936.13    935.89   935.88   935.88

                    CUMULATIVE AREA =  0.28 SQ MI

***                    ***                    ***

              HYDROGRAPH AT STATION      A2
              FOR PLAN 1. RATIO = 0.25

PEAK OUTFLOW IS   227. AT TIME  16.33 HOURS

PEAK FLOW      TIME              MAXIMUM AVERAGE FLOW
(CFS)          (HR)         6-HR      24-HR    72-HR    24.92-HR
227.           16.33        122.      38.      36.      36.
                (INCHES)    4.557     5.000    5.000
                (AC-FT)     61.       75.      75.

PEAK STORAGE   TIME              MAXIMUM AVERAGE STORAGE
(AC-FT)        (HR)         6-HR      24-HR    72-HR    24.92-HR
84.            16.33        75.       63.      63.      63.

PEAK STAGE     TIME              MAXIMUM AVERAGE STAGE
(FEET)         (HR)         6-HR      24-HR    72-HR    24.92-HR
937.46         16.33        936.71    936.08   936.07   936.07

                    CUMULATIVE AREA =  0.28 SQ MI

***                    ***                    ***

              HYDROGRAPH AT STATION      A2
              FOR PLAN 1. RATIO = 0.50

PEAK OUTFLOW IS   637. AT TIME  16.17 HOURS

PEAK FLOW      TIME              MAXIMUM AVERAGE FLOW
(CFS)          (HR)         6-HR      24-HR    72-HR    24.92-HR
637.           16.17        256.      76.      73.      73.
                (INCHES)    6.501     10.133   10.133
                (AC-FT)     127.      151.     151.

PEAK STORAGE   TIME              MAXIMUM AVERAGE STORAGE
(AC-FT)        (HR)         6-HR      24-HR    72-HR    24.92-HR
99.            16.17        84.       67.      66.      66.

PEAK STAGE     TIME              MAXIMUM AVERAGE STAGE
(FEET)         (HR)         6-HR      24-HR    72-HR    24.92-HR
938.33         16.17        937.27    936.29   936.27   936.27

                    CUMULATIVE AREA =  0.28 SQ MI
```

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIO 1 0.10	RATIOS APPLIED TO FLOWS RATIO 2 0.25	RATIO 3 0.50
HYDROGRAPH AT	A1	0.28	1	FLOW	174.	435.	870.
				TIME	15.92	15.92	15.92
ROUTED TO	A2	0.28	1	FLOW	74.	227.	637.
				TIME	16.50	16.33	16.17
** PEAK STAGES IN FEET **							
	1			STAGE	936.56	937.45	938.33
				TIME	16.50	16.33	16.17

SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION   A2

PLAN 1 ....

	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	935.70	935.70	937.40
	OUTFLOW	57.	57.	83.
		0.	0.	205.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.10	936.56	0.0	70.	74.	0.0	16.50	0.0
0.25	937.46	0.06	84.	227.	0.58	16.33	0.0
0.50	938.33	0.93	99.	637.	3.00	16.17	0.0

*** NORMAL END OF JOB ***

APPENDIX 5

REFERENCES

CARPI LAKE DAM

APPENDIX 5
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